January usually, after March at latest the ice could hardly be held responsible for any trouble, even were it known to be infected." It should be borne in mind, however, that the work of the authorities referred to and upon which this conclusion is based was done under artificial conditions, and in its natural environment the bacillus now appears to have a greater resistance, not heretofore recognized. In our review of the literature we have been unable to find any similar cases reported, and in the article quoted the statement is made that only a single authentic case is on record.

With the discontinuance of the use of the infected ice the epidemic gradually subsided. There were in all thirty-nine cases, the last of which developed in November. Our water is not boiled, and the conditions, with the exception of the ice, are the same as at the beginning of the epidemic.

THE TRANSMISSION OF BOVINE TUBERCULOSIS BY MILK, WITH A TABULATION OF EIGHTY-SIX CASES.

By George M. Kober, M.D.,
PROFESSOR OF HYGIENE, SCHOOL OF MEDICINE, GEORGETOWN UNIVERSITY, WASHINGTON, D. C.

The agency of milk in the causation of scrofula was referred to by Carmichael[1] in his *Essay on the Nature of Scrofula, with Evidence of its Origin from Disorders of the Digestive Organs*, London, 1810, in which he refers to *acescent* (sour) diet, especially of cow's milk, as a frequent cause. On page 50 he says: "Infants at the time of weaning are from the change of diet particularly subject to bowel complaints, too often followed by disease of the mesenteric and lymphatic glands."

He quotes Richard Wiseman (1626–1686), White (1787), and Lieutand to show that whenever the outward glands appear swollen, one may safely conclude the mesenteric to be so, too, they being usually the first part that is attacked by this malady. Indeed, Carmichael, while he never saw a subject in the dissecting-room with strumous glands externally without a similar state of those of the mesentery, claims that he has very frequently seen the latter unaccompanied by any affection of the external glands, which to his mind indicates that in scrofula the mesenteric glands are the first involved.

While Carmichael did not attempt to prove the transmission of scrofula in the milk of diseased cows, he points with emphasis to the use of sour milk, and on page 101, remarks:

> "With respect to the disease in question, we know that swine are so subject to one very similar that scrofula has in consequence derived its name

from those animals, and certainly their extraordinary fondness for *acescent* food corroborates in some degree the foregoing opinion. Swine, it is well known, fatten upon buttermilk and upon the sour liquid formed in starch manufacture during the steeping of wheat."

These are suggestive statements, especially as, in the opinion of veterinarians of the present day, tuberculosis is increasing among swine, largely as a result of consuming tuberculous milk. According to Salmon,[2] during the year 1900, of 23,336,884 hogs slaughtered under Federal inspection, 5444 were sufficiently affected to cause condemnation of some part of the carcass.

Casper,[3] in his *Characteristics of French Medicine*, etc., published in 1822, on page 124, writes:

> "Scrofula is not more rare in Paris than elsewhere, and baffles also here the efforts of physicians. La Billardière declares that the majority of milch cows in Paris perish from nodular consumption, and that their milk contains seven times more of lime phosphate than common. It is possible that there is a connection between this phenomenon and the many tuberculous diseases among the children in Paris. We cannot pursue here this investigation, where the mere fact suffices that in Paris, especially in the hospitals for foundlings and for children, like the St. Louis and others, the sequela and effects of scrofula can be seen in astonishing numbers."

La Billardière's[4] statement that the milk of tuberculous cows contains seven times more of lime phosphate than common is of special interest in view of Dr. de Schweinitz's[5] recent biochemical researches upon bovine, swine, avian, virulent human, and attenuated human tubercle bacilli, in which he calls attention to the large amount of phosphoric acid obtained from the germs, and also points out that the conclusions which might be drawn from these analyses indicate a closer resemblance in the composition of the germs between the moderately virulent human and the very attenuated human bacilli.

Klencke,[6] in 1846, was the first to write on the infectiousness and transmission of scrofula by cow's milk. In his book of ninety pages he gives the clinical histories of sixteen children who had been fed with the milk of scrofulous and tuberculous cows, and they all point to tuberculosis of either the intestines, glands, skin, or bone. He also describes the condition of the seven suspected cows, and verified the diagnosis of a "scrofulous-tuberculous condition" in four post-mortem examinations of the cows, which demonstrated to his satisfaction "that the same scrofulous lesions may be developed in the cow as are found in the human subject and that human scrofula and the disease found in the mammalia are identical." The details of these cases were republished by the writer in 1895.

Klencke's contribution to the early literature of this subject may be regarded of special value, as he was one of the first to demonstrate the infectious nature of tuberculosis by injecting, in 1843,[7] human tuberculous matter into the cervical veins of rabbits, causing pulmonary and hepatic tuberculosis in these animals In passing it should be stated that inoculation experiments had been made by Kortum (1789), Hébréad (1802), Salmade (1805), Goodlad and Deygallières (1829), Lepelletier (1830), and Laennec and Erdt (1834[8]). These experiments naturally paved the way for Villemin's[9] brilliant and positive demonstrations in 1865.

Since that time numerous instances of artificial tuberculosis have been reported, the experiments having been performed on heifers, calves, goats, swine, guinea-pigs, rabbits, and dogs; so, for instance, under the heading of *subcutaneous inoculation methods* may be mentioned the work of Soujou and Court Paul,[10] Gerlach,[11] Günther and Harms,[12] Rivolto and Perroncito,[13] Bagge,[14] Zürn,[15] Bollinger,[16] Biffi and Verga,[17] Bouley,[18] Aufrecht,[19] Toussaint,[20] and others. *Intraperitoneal inoculations* were reported by Klebs,[21] 1870, Bollinger,[16] 1873, and Kitt,[22] 1878. *Intravascular inoculations* were reported by Semmer, Thal, and Nesterow.[23] *Intraocular inoculations* were reported by Cohnheim and Salomonson,[24] Hänsell and Deutschmann,[25] and Baumgarten;[26] and finally the *inhalation experiments* by Tappeiner,[27] Lippl, Reinstadler and Bertheau[28] may be cited.

It is true that opposing views were held and quite a number of negative experiments have been reported, but on the whole the results were sufficiently numerous and uniform to demonstrate the identity of scrofula and tuberculosis and the intercommunicability of tuberculosis in animals and man. This evidence was materially strengthened by the feeding experiments of Gerlach,[29] Chauveau,[30] Bollinger,[31] Klebs,[21] Zürn,[15] Roloff,[32] Brell,[33] Metzguer,[34] Langeron,[35] Blumenberg,[36] Orth,[37] Lange,[38] Peuch,[39] Peuch and Toussaint,[40] Aufrecht,[41] and others.

Bollinger[42] in the discussion of artificial tuberculosis before the German Naturalists and Physicians in 1879 (which was participated in by v. Recklinghausen, Arnold, Birch-Hirschfeld and Fränkel) had no hesitation in declaring that milk from tuberculous cows is largely responsible for the production of scrofula, which affects about 70 per cent. of the children in Munich.

E. Klebs,[43] from his experiments in 1871–1873, concluded that milk from tuberculous cows produces tuberculosis in different animals; that the disease commonly begins with an intestinal catarrh, followed by tuberculous affections of the mesenteric glands, involvement of the liver and spleen, and finally by extensive miliary tuberculosis of the pulmonary organs, and Virchow,[44] in 1880, suggested that bovine tuberculosis may be conveyed in the milk, especially if the udder be the seat of the lesion. In the meantime a number of cases of transmission of bovine tuberculosis in milk had been reported by Schoengen,[45] Leonhardt,[46] Bollinger and Stang,[47] Demme,[48] Epstein,[49] Uffelmann,[50] Johne,[8] and Law.[51] Creighton,[52] in 1881, published a book on bovine tuberculosis in which he presents a minute study of a number of cases of tuberculosis in man which had the characteristics of an infection and at the same time a suggestive likeness in the morbid products to the bovine form of tuberculosis (*perlsucht*). Indeed, the evidence on this subject appeared sufficiently strong to justify Koch,[53] in 1882, in declaring:

> "It is not the peculiar structure of the tubercle, nor its lack of blood-vessels, nor the presence of giant cells, that will give the solution, but rather the proof of the tuberculosis bacillus, whether it be in the tissue by means of staining reaction or whether it be by means of culture upon coagulated blood serum. This criterion being adopted as a foundation principle, according to my investigations miliary tuberculosis, caseous pneumonia, caseous bronchitis, intestinal and glandular tuberculosis, bovine tuberculosis, spontaneous and inoculation tuberculosis of animals must be declared as identical. . . . Bovine tuberculosis is identical with human tuberculosis, and, therefore, a disease transmissible to man. It should be treated just like other infectious diseases transmissible from animals to human beings. However great or small may be the danger which results from the consumption of meat or milk affected with bovine tuberculosis, it is present, and must be, therefore, avoided.

Soon after Koch's discovery of the tubercle bacillus diligent search was made for the presence of this organism in the milk of diseased cows, and it was demonstrated by Csokor,[54] Bang,[55] Johne,[56] Bollinger,[57] May,[58] Ernst,[59] Woodhead and MacFadyean,[60] Martin,[61] Nocard,[62] Stein,[63] Hirschberger,[64] and others. Some observers, notably Martin[61] and Nocard,[62] found that milk was infective only when the udder was itself the seat of tuberculous lesions; but Ernst, as early as 1889, and Theobald Smith,[65] in 1893, from a number of experimental observations, concluded that tubercle bacilli may be present in the milk of tuberculous cows when the udder, so far as the naked eye could tell, contained no focus of disease. These conclusions are, moreover, supported by the investigations of Bang, Stein, Bollinger, Adami, Delépine, and Hirschberger.

Quite a number of observers failed to find tubercle bacilli in the milk of tuberculous animals; but May[58] and Hirschberger[64] proved that inoculation experiments are the more certain guide as to whether milk is infectious or not, since they obtained positive results from milk of undoubtedly tuberculous animals in which they were unable to demonstrate the presence of tubercle bacilli. As a matter of fact, Rabinowitsch and Kempener[66] obtained positive results in inoculation experiments with the milk of ten out of fifteen cows that had reacted to tuberculin, and only two of these animals revealed udder lesions.

The general results of inoculation experiments differ in different countries, and naturally vary with the prevalence of bovine tuberculosis, the mode of technic, and many other factors.

The reports indicate that the infectious qualities are greatest with milk from animals with udder lesions, and next from those affected with general tuberculosis.

Bollinger[67] found that the general market milk of Munich proved infectious in 16.6 per cent. of the animals; Martin in Paris, in 33 per cent.; Bang in Copenhagen, in 15.5 per cent.; Ernst in Boston, in 12 per cent.; Fiorentini in Milan, in 10 per cent.; Rabinowitsch, in 28 per cent.; Obermüller, in 7.5 per cent.; Paris Municipal Laboratory, in 40 per cent.; Hamilton, Boyce, Woodhead, and Delépine in Liverpool, in 29 per cent.; Delépine in Manchester, in 25 per cent.; Massone, in 9 per cent.; Ott, in 11.6 per cent.; Jäger in Königsberg, in 7 per cent.; Kanthack and Sladen[68] found more than 50 per cent. of the milk supplied to the college in Cambridge infectious.

The experiments reported by Schmidt-Mühlheim, May, Stein, Hirschberger and Bang, and which were made with milk from tuberculous cows, proved successful in 60 to 70 per cent. of the animals.

In addition and, perhaps, of greater importance to the subject are, of course, the feeding experiments. Disregarding the earlier experiments of Gerlach and Bollinger, we have the important and positive results obtained by Baumgarten,[70] Wesener,[71] Fischer,[72] Peuch,[73] Ernst,[74] Bang,[55] Falk,[75] Zagari,[76] and Gebhardt,[77] showing that after a variable period, usually between eleven and twelve weeks, the ingestion of tuberculous milk developed a classical tuberculosis either of the intestinal mucosa and mesenteric glands, or spleen and liver, followed by subsequent involvement of other organs. In some, but not many, of these cases there was evidence of primary intestinal tuberculosis, but almost all of the cases revealed infection of the mesenteric glands. In the cases where the primary lesions were found elsewhere than in the intestines or mesenteric glands, Wesener,[71] in 1885, suggested that the bacilli must have found their way into the general circulation. As a matter of fact, the experiments of Dobroklonski,[78] Desoubry and Porcher,[79] of Nicolas and Descos,[80] have since shown that microbes may pass through the intestinal wall and enter the thoracic duct. The last-named experimenters, in 1902, brought out the interesting fact that three hours after the ingestion of tubercle bacilli the chyle and the lymph of the thoracic duct may contain bacilli in sufficient number to infect a guinea-pig, and we know from Wyssokowitschky's[81] experiments that from eight to thirty virulent tubercle bacilli introduced into the peritoneal cavity of a guinea-pig are required to bring about infection.

It should be stated that in the feeding experiments by Günther and Harms,[82] Siedamgrotzky,[83] Roloff,[32] Bollinger,[42] and Nosotti the results were not uniformly successful, and that Schreiber,[85] Günther and Harms[82] have reported negative results.

On the whole, however, the feeding experiments with tuberculous milk proved infectious in about 45 to 50 per cent. of the cases. This seems excessive, probably because many of the negative results were never reported.

Apart from these experiments, we have the reports of Lucas and Morro,[86] Utz,[87] Klebs,[88] Kruckow,[89] Pfennigwerth,[90] Vollers,[91] Woodhead,[92] and others to show that the disease may be transmitted in milk to calves and pigs and other animals.

It is interesting to note that Bang,[55] May,[58] and Woodhead[60] noted a marked difference in the resulting lesions with raw milk and milk which had been subjected to different degrees of temperature. So, for example, Bang found that while a temperature of 158° F. did not destroy the vitality of the organisms, it reduced their virulence; and Woodhead, by the operation of certain low temperatures, obtained a diminution in the virulence of the tuberculous material in milk, which then "became so tardy in its operation on the test animals as to simulate the slower forms of consumption seen in the human subject, or when used to feed pigs—animals having some specialties of throat structure like that of man—gave rise to chronic enlargement of the throat glands resembling the scrofulous glands so common in children."

In the meantime 56 additional cases of transmission of bovine tuberculosis through the medium of the milk supply had been reported by Law,[93] Demme,[94] Sonntag,[69] Meyerhoff,[95] Hermsdorff,[96] Northrup,[97] Ollivier,[98] Wyss,[99] Gosse,[100] Rotch and de Schweinitz,[102] Law,[103] Rich,[104] J. L. Smith,[105] Ernst,[74] Brouardell,[106] Von Ruck,[107] Hills,[108] Prümers,[109] and Bovaird.[109] A number of accidental inoculations (wound infections) in man with bovine bacilli had also been placed on record by Pfeiffer,[110] Hartzell,[111] Rich,[104] Tscherning,[112] Law,[113] Ravenel,[114] Naughton[115]. These and the cases reported by Grothan,[116] Coppez,[117] and Priester[118] of primary subcutaneous tuberculosis caused by the topical application of cream, infection in milking, and the introduction of infected milk in the attempt to remove tattoo marks, had materially strengthened the evidence as to the transmissibility of bovine tuberculosis to man. Indeed, the absolute identity of tubercle bacilli infecting mammalia was generally assumed until Theobald Smith,[119] in 1896, presented to the Association of American Physicians a comparative study of a bovine bacillus and a presumably human bacillus in which the morphological and biological differences were sufficiently marked to suggest further study; and as a result of this research Smith,[120] in 1898, stated that "we are justified if only to guide and stimulate further study in establishing a distinctively human or sputum and a bovine variety of the tubercle bacillus." He also expressed the opinion that the comparative study of the tubercle bacilli will lead to some definite understanding on certain important questions and eventually to more light on the whole subject of tuberculosis from the preventive as well as the therapeutic side. Notwithstanding these facts and the observations of Martin,[61] in 1895, that human sputum was far less virulent for animals than was bovine tuberculous material, the announcement of Koch before the International Congress for the Prevention of Tuberculosis, held in London July 22 to 26, 1901, was received with astonishment, especially since his conclusions carry with it a reversal of his judgment rendered in 1882.

Koch, in his address of 1901, makes the following declarations:[121]

> "1. The bacilli found in cases of bovine tuberculosis are much more virulent for cattle and other domestic quadrupeds than the bacilli found in cases of human tuberculosis.
>
> "2. This difference is so marked and so constant that it may be relied upon as a means of distinguishing the bacilli of bovine tuberculosis from those of the human disease, even assuming that the former may occasionally be found as a cause of disease in man.
>
> "3. If bovine bacilli are capable of causing disease in man, there are abundant opportunities for the transference of the bacilli from the one species to the other, and cases of primary intestinal tuberculosis from the consumption of tuberculous milk ought to be of common occurrence. But post-mortem examination of human beings proves that cases of primary intestinal tuberculosis are extremely rare in man, and, therefore, it must be concluded that the human subject is immune against infection with the bovine bacilli, or is so slightly susceptible that it is not necessary to take any steps to counteract the risk of infection in this way."

Fortunately for the advancement of science, opposition fosters the spirit of inquiry, and many experiments have been made which have shed new light upon the already voluminous testimony. While it is true that the results in the feeding experiments with human sputum have varied, and that some of the earlier experimenters have reported negative results, the weight of the testimony is clearly in favor of the intercommunicability of human and bovine tuberculosis; and the experiments made during the past two years by Ravenel,[122] de Schweinitz,[123] Mohler,[123] Orth,[124] de Jong,[125] Stenström,[125] Fibiger,[125] Wolff,[125] Nocard,[125] Arloing,[125] v. Behring,[125] Dean and Todd,[125] and Cipollina[135] conclusively demonstrate that cattle are not refractory to human tuberculosis and that bovine tuberculosis may be transmitted to monkeys. Whatever differences have been observed may very properly be attributed to the condition of the host and to the different degrees of virulence found in human bacilli, as shown by the work of Vagedes,[126] 1896, Lartigan,[127] and Delépine.[128]

The former studied twenty-eight human cultures, and found one much more virulent than the others and even more virulent than either of the two bovine cultures. Lartigan found bacilli of different degrees of virulence in human tuberculosis, and one of his specimens presented morphological and cultural peculiarities which suggested the bovine origin described by Smith. Delépine obtained from the human subject bacilli just as virulent as the bovine organisms, although in most instances the human tubercle bacillus was less virulent.

The writer has tabulated 86 cases of milk bovine tuberculosis, and quite a large number of cases of transmission of bovine tuberculosis to man have been reported by Krause,[128] Ravenel,[129] Lassar,[125] Hüls,[125] Spronck and Hoefnagel,[125] and Troje.[137] New light has also been shed upon the extent of intestinal infection by the statistics of Heller,[130] who finds that in 714 autopsies in children who died from diphtheria 140 (19.6 per cent.) were tuberculous, and of these 30.7 per cent. showed primary lesions in the intestines or mesenteric glands; 2 (1.43 per cent.) showed primary intestinal tuberculosis; 8 (5.7 per cent.) showed primary intestinal mesenteric glands; and 33 (23.5 per cent.) showed primary mesenteric gland tuberculosis.

Bovaird's[131] collection of primary intestinal tuberculosis in children is summarized as follows:

	Total.	*Intestinal.*	*Per cent.*
German	236	9	4
French	128	0	0
English	748	136	18
American	369	5	1

Dr. Bovaird confesses his inability to understand or explain the difference. The facts are that the post-mortem returns are extremely conflicting, and, unless accounted for by a variable prevalence of bovine tuberculosis and the habit of feeding raw or sterilized milk, suggest the necessity of more careful post-mortem work.

The statistical work by Gottstein[132] shows that the mortality from tuberculosis in breast-fed children is but slightly more than half as much as among those otherwise nourished, the proportion being as 6 : 10. Salmon[133] has analyzed the vital statistics of Massachusetts and finds an increase of 36 per cent. in the forms of tuberculosis other than phthisis in the class under five years of age, while there was a reduction in the mortality of phthisis at all other ages of about 45 per cent., and the vital statistics of Michigan from 1885 to 1900 show also a tremendous increase during the milk-drinking age.

Dr. Hand's[136] statistics are as follows:

	Cases.	*Per cent.*
Total number of autopsies	332	
Total number showing tuberculosis	115	34.6
Apparent portal of infection (Hutinel's tuberculous chancre).		
Oldest lesion in the bronchial glands	75	62.2
Oldest lesion in the mesenteric glands	10	8.7
Process so general that the portal could not be determined	27	23.4

The cases of milk-borne tuberculosis, now numbering 86, while not as large as commonly supposed, are considerable when we consider the difficulty of tracing the infection on account of the more insidious character of the disease. In this connection we should remember that the first milk-typhoid epidemic was reported by Jacobs in 1858; in 1881 Mr. Ernst Hart had collected fifty epidemics, and in 1900 the writer tabulated 195 such epidemics. The opportunities for tracing bovine infection are much better in small communities and in isolated farm-houses than in large cities, and we should look to the country practitioner for help; he, in turn, unless properly equipped to verify his diagnosis, should apply to the Bureau of Animal Industry, or to the pathologist and bacteriologist of his medical school to check up his work.

A careful review of the cases recorded, when taken in connection with the laboratory experiments and the general evidence, justifies the following conclusions:

1. Tuberculosis may be transmitted to man in milk from tuberculous cows. The danger from this source is real and cannot be measured by the actual number of recorded cases, but should be judged in part, at least, by the inoculation and feeding experiments and the accidental wound infections which have established the intercommunicability of bovine and human tuberculosis.

2. The degree of danger may also be estimated by the prevalence of bovine tuberculosis and of the forms other than phthisis pulmonalis in man, remembering that the infectious qualities of milk are greatest when the udder is the seat of lesions, and that Gebhardt's experiments have shown that tuberculous milk when diluted with the milk of sound animals in the proportion of 1:40 lost its infective power.

3. The experimental studies also indicate that while the bacilli of human tuberculosis possess different degrees of pathogenic power and

are often of feeble virulence for cattle, Koch's assumption that human and bovine tuberculosis are distinct and that human tuberculosis cannot be conveyed to cattle appears to be disproved, and his failure to secure similar results may be attributed to the use of human bacilli of diminished virulence.

4. Recent investigations have strengthened Smith's claim that there are two types of tubercle bacilli—the so-called bovine and human types, possessing certain morphological and biological differences; but it has also been shown that virulent cultures may be obtained from both of these types, which when inoculated into animals produce the disease in question.

5. Further research seems desirable with a view of determining the frequency of primary intestinal and abdominal tuberculosis in all cases which come to autopsy, whether the child perished from tuberculosis or not; and in these autopsies the bacteriological examination should be directed to the existence of the two types of tubercle bacilli originally referred to by Smith, and whether the bovine type predominates in the so-called scrofulous lesions.

6. Careful chemical analyses of the milk of tuberculous animals should be made with a view of determining the amount of phosphoric acid as compared with the quantity in normal milk, since it appears probable from Dr. de Schweinitz's biochemical researches that the excess noted by the older chemists is really the result of bacterial activity in the udder of the cow.

7. In the meantime the pathologist has no occasion to reverse his opinion as to the identity of human and bovine tuberculosis, and the sanitarian has no reason to assume that the human subject is immune against infection with the bovine bacilli or is so slightly susceptible as to cause him to relax his efforts in preventive measures.

The writer desires to express his acknowledgments to Dr. D. E. Salmon, Chief of the Bureau of Animal Industry, U. S. Department of Agriculture, for material assistance in the preparation of this paper by placing at his disposal unpublished reports of experimental work.

Abstracts of Reports of Cases of Tuberculosis Attributed to Infected Cow's Milk.

Cases 1 to 16, 1846. Professor Klencke,[6] in a book of ninety pages, gives the clinical histories of sixteen children who had been fed with the milk of "scrofulous-tuberculous cows," and all of these cases point to tuberculosis of either the intestines, glands, skin, or bone. In three of the intestinal disorders he refers to the presence of indurated mesenteric glands. Of these cases one died, and two at the time of the report were in a hopeless condition. The clinical histories show that four of the children had been fed with milk from Cow B, three received their supply from Cow D, four from Cow E, two from Cow F, and three from Cow G. Professor Klencke, having connected these cases with a particular milk supply, extended his investigation into the condition of the cows—their sanitary environments—together with a chemical and microscopic examination of the milk, and actually followed up his inquiry by four autopsies of the cows, in which he demonstrated scrofulous-tuberculous lesions. Such a course is worthy of emulation, and almost complies with the conditions of proof exacted by Professor Koch. Copious abstracts of these cases were published by the writer in the report of the Health Officer, District of Columbia, 1895.

Case 17. Schoengen,[45] at a meeting of the Veterinary Society held at Cologne, October 18, 1873, related the history of a child who, upon the advice of the family physician, was placed on cow's milk and developed undefined symptoms suggestive of tuberculous infection. An examination of the cow by a veterinarian resulted in a diagnosis of perlsucht, which was confirmed by post-mortem. A change of the milk resulted in subsequent improvement of the child.

Cases 18 and 19. K. Leonhardt,[46] December, 1874, reports the case of a child, previously healthy, which contracted tuberculosis soon after being weaned, and died. The autopsy revealed tuberculous meningitis and extensive lesions of the intestines and mesentric glands, which were undergoing caseous degeneration; attributed to the use of unboiled milk from a tuberculous cow.

The second case, also one of tuberculous meningitis, occurred in a previously healthy child after the consumption of milk from a cow which, upon examination, proved to be tuberculous.

He also mentions the history of a forester's family in which the children, although previously perfectly healthy, invariably developed tuberculosis after weaning. The cow was finally slaughtered, and the autopsy revealed extensive tuberculosis. A child, born subsequently, remained perfectly healthy.

Case 20. Professor O. Bollinger,[47] January 25, 1876, reports that Dr. Stang, of Amorbach, treated a boy, aged five years, well developed and of healthy parentage; no family history of tuberculosis for two generations. The child first developed symptoms of tabes mesenterica, and died some weeks later of miliary tuberculosis of the lungs, with enormous hypertrophy of the mesenteric glands, which were also undergoing caseous degeneration. While the post-mortem was being made it was ascertained that a short time previously the parents had a cow slaughtered, which was found by the veterinary surgeon at the abattoir to have phthisis pommelière. This cow had been a good milker, and for a long time the boy had been in the habit of drinking its milk, directly after the milking, in a raw state.

Case 21. Professor R. Demme,[48] 1879, reports the case of a previously healthy boy who was breast-fed until the fifth month, after which he was fed on cow's milk, and developed intestinal tuberculosis involving the mesenteric glands. The child died after three months' illness. Post-mortem examination revealed extensive tuberculosis of the intestines, especially of the jejunum and ileum and of the mesenteric glands; lungs and meninges showed no evidence of involvement. The cow died some months later, and Demme demonstrated, both macroscopically and microscopically, perlsucht.

Cases 22 to 25. Professor Demme, 1882, reports four cases of intestinal tuberculosis which, from the family history and the clinical and pathological evidence, he attributed to infection from milk from tuberculous cows.

Case 26. Alois Epstein,[49] 1879, reports the case of a child, three months old, in which the autopsy revealed follicular ulceration of the intestines, with involvement of the mesenteric glands and evidence of miliary tuberculosis in other organs. The author quotes Steiner and Neureiter, who in 302 tuberculous children found involvement of the lymphatic glands in 299 instances, and in 91 cases, or 30 per cent., the glands alone were involved. In 17 of 312 cases collected by Rilliet and Barthez there was no evidence of pulmonary lesions, and from this and a large amount of other evidence he concludes that the portals of infection may be through the digestive as well as the respiratory tract.

Case 27. Professor J. Uffelmann,[50] 1880, reports the case of a child which was fed five months with milk from a certain cow. About the seventh month the child presented symptoms of bronchial catarrh and involvement of the superficial lymphatic glands. The child died at the age of eleven months with hectic fever and abdominal symptoms. No autopsy.

The cow was found to be tuberculous. The proof is not conclusive, but Professor Uffelmann is well known as a conservative writer and teacher.

Case 28. Albert Johne,[8] 1880, reports a case in which the post-mortem examination of a cow revealed extensive tuberculous deposits in the lungs and abdominal organs, which had been sent to him for inspection by the owner, who was especially interested in the result of the investigation, on account of the fact that up to within the past few weeks the cow was one of the best-nourished animals in his stables, and the milk had been selected by the steward for his infant son. The family physician was at once notified of the results of the autopsy, and reported progressive emaciation and a pulmonary catarrh which he had attributed to a recent attack of measles. A short time afterward Johne learned that the child perished from miliary tuberculosis of the brain.

Case 29. Law,[51] 1880, refers to a case reported to him by Dr. Corliss, of New Jersey. A family cow, supposed to be suffering from the lung plague, was found to be affected with tuberculosis instead, and the owner's wife (a consumptive), who had been making free use of the milk, warm from the cow, was persuaded to give it up and underwent decided improvement.

Cases 30 to 33. Law,[93] 1883, cites two cases, daughters of a Scotch family, strong and healthy, who were brought up on milk of tuberculous cows and died of tuberculosis, while two sons in the same family who did not use the milk remained healthy. See, also, Hills and Rich in *Bulletin* 42, *Vermont Vet. Exper. Station*, p. 55.

Mr. Howe, of North Hadley, Mass., lost a son, twenty months old, from abdominal tuberculosis three months after he paid a week's visit to his uncle and had been fed with the milk of the uncle's cow. The cow was killed soon after and proved to have generalized tuberculosis. The child's sickness and wasting began a few weeks after he returned home. He had previously been strong and healthy, as were and are his parents. (Cited by Law from *Report of Vet. Congress*, at Brussels, 1883, p. 288; also, by Nocard from *Compte rendu of Fourth Internat. Vet. Congress*, Brussels, 1883, p. 188; and by Salmon, *Bulletin No.* 33, *Bureau of Animal Industry*, 1901, p. 21.)

Case 34. H. Meyerhoff,[95] 1884, reports the case of a child, seven years of age, of healthy parentage and with a good family history, who developed tuberculosis after drinking for a long time milk from a cow suffering with pearl disease. Although the patient had also worn some infected clothing, Meyerhoff attributes the infection to the milk.

Case 35. Demme,[48] 1886, reports the case of a boy, four months of age, who developed tuberculosis of the mesenteric glands without the slightest lesion in the intestinal walls. The child was fed on unboiled milk from a tuberculous cow, as shown by the autopsy. Tubercle bacilli were isolated from the udder as well as from the mesenteric glands.

Among 2000 tuberculous children treated during the past twenty years at the hospital Dr. Demme, a very conservative and competent authority, reported this and the preceding cases as milk-borne infections.

Case 36. Law,[93] 1894. A child, four years old, son of Col. Beecher and a grandson of Henry Ward Beecher, died March, 1894, at Yonkers, N. Y., of tuberculous meningitis. The diagnosis was confirmed by specialists. There were no known hereditary tendencies to the disease. The certainty that he had the disease, and the inability to account for it from human agencies, led the physician to suspect the milk of two Alderney cows, on which the child had been mainly fed. The tuberculin test and post-mortem showed that both animals were tuberculous.

Case 37. Sonntag, quoted by Baum,[69] page 196, reports the case of a child, aged six months, which died from tuberculous meningitis. The parents were perfectly healthy, but the child had been almost exclusively fed with milk from a tuberculous cow.

Case 38. Hermsdorf[96] reports the case of a girl, aged fourteen years, of good family history and healthy stock, who died from tuberculous laryngitis. The most extensive lesions were found in the ileum and cæcum. The pulmonary lesions were slight. Inquiry revealed the fact that the girl had been in the habit of drinking the milk while still warm from a tuberculous cow.

Case 39. W. P. Northrup,[97] 1890, reports the case of an infant, aged fifteen months, which was brought to the New York Foundling Hospital when two hours old, placed with a wet-nurse, from whom it was taken in the twelfth month on account of its miserable condition, developed general tuberculosis, —primary intestinal infection—possibly from food infection.

Cases 40 to 52. Ollivier,[98] 1897, presented to the Paris Academy of Medicine, February 24, 1891, the history of twelve young ladies, scholars in the Pension of the Dames Blanches at Chartres, all suffering from tuberculosis, of whom five died, the last death from tuberculous meningitis. A few days later the milch cow was butchered and found to be suffering from tuberculosis of the udder and of the internal organs. In almost all of the cases there was evidence of intestinal involvement, and in none of the cases was there an inherited predisposition. Professor Koch in a recent address states that Ollivier in a subsequent communication before the Academy remarked that only the servants had consumed the milk from the tuberculous cow.

Cases 53 and 54. Professor Oscar Wyss,[99] 1893, reports three cases in 123 autopsies on children, aged five and three-fourths years, six and a-half years, and two years, coming within the observation of competent clinicians during a period of three years, in which tubercle bacilli were found in the primary intestinal lesions, and all were strongly suspected of being caused by infected cow's milk.

Case 55. Gosse,[100] 1893, reports the case of his own daughter, who, up to within a year of her death, was perfectly healthy, developed tuberculosis of the intestines and mesentery, which the father traced to the consumption of raw milk from some of the cows on his own farm, which were found to react to tuberculin, and post-mortem examination revealed tuberculous lesions of the udder.

Case 56. Thomas M. Rotch and E. A. de Schweinitz,[102] 1893 or 1894. The case was under the care of Dr. Rotch in the Children's Hospital in Boston in 1893 or 1894. The particulars were sent to Dr. de Schweinitz, of the Bureau of Animal Industry, by Dr. Rotch. A boy, aged seven years, had been drinking a great deal of milk from one cow for about four months before entering the hospital. The cow was found to be tuberculous, the disease being demonstrated by autopsy. The boy was a case of primary tuberculous peritonitis with effusion. Laparotomy was performed by Dr. Bradford and a large amount of serous fluid evacuated. The peritoneum was found to be thickly studded with minute tubercles, and the presence of tubercle bacilli was demonstrated. Four years after the operation the boy was found to be perfectly well, and seemed free from tuberculosis.

Cases 57 to 64. Brouardel,[106] 1894 (quoted by Harrington, *Practical Hygiene*, 1902, page 102), records the death of seven children with no hereditary taint, inmates of a convent, from tuberculosis, supposedly induced by the use of milk from a cow with tuberculosis of the udder. Another case reported by him and quoted by Freudenreich (*Les Microbes es leur des Role dans la Laiterie*, Paris, 1894, p. 45) is one in which five of fourteen girls in a boarding school became infected and died. The milk which they had used daily came from a tuberculous cow. These cases and Ollivier's collection are of special value on account of the number of persons affected who have taken the same milk, the intestinal lesions, and the demonstration of tuberculous udders.

Case 65. Law,[103] 1894, reports the case of a strong, vigorous boy, aged one and a-half years, who for a week drank the milk of a cow which was shortly afterward condemned and killed in a state of generalized tuberculosis. In six weeks the child was noticeably falling off, and in three months died, a mere skeleton, with tuberculosis of the abdomen. The father could trace no tuberculosis in his near ancestors, but the mother's father and uncle had died of it. She, herself, was in perfect health.

Cases 66 to 68. F. A. Rich,[104] 1895, reports several cases: Case 1, Mr. C., a young man of healthy parents, died of tuberculosis. Three years later Rich tested the herd of cows from which the patient had used milk plentifully, destroyed sixty-five out of seventy-four, many of which proved, upon post-mortem examination, to be affected with general and far-advanced tuberculosis. A few months later the owner of the herd developed acute pulmonary tuberculosis, and at the close of the report was in an advanced stage of the disease. Case 2, Mr. D., a young man, died of pulmonary tuberculosis. Two months later Rich tested the herd and destroyed eighty animals, nearly 90 per cent. of the herd. Several calves and hogs were found to be tuberculous from feeding upon the milk. Case 3, Miss R , using milk from a tuberculous cow, developed symptoms of pulmonary consumption. The cow was exchanged for another, and she apparently recovered. Three years later she went to live where the above-mentioned cow was still owned and milked, and in a short time developed acute miliary tuberculosis, from which she died a month later, and the autopsy revealed general tuberculosis.

Case 69. J. L. Smith,[105] November 14, 1895, reports a case of tuberculosis in which it seemed clear that the disease had been transmitted to the little one by infected milk. The child was in charge of one of the wet-nurses of the New York Foundling Asylum, and then had been partly fed on milk from a small grocery store. Dr. R. G. Freeman found no ulceration of the intestines. The condition of the mesenteric gland, that had undergone cheesy degeneration, showed that here was the oldest lesion, and it, therefore, indicated an intestinal infection.

Cases 70 to 81. H. C. Ernst,[59] 1895. Of the 1013 replies from physicians to Ernst's questions whether they knew of cases of transmission, 895 were in the negative; 8 reported transmission from mother to child; 11 reported cases of infection through cow's milk, and 16 reported suspicious cases. Of 54 replies to the same question from veterinarians, 14 reported positive cases and 9 suspicious cases.

Case 82. M. Volkoff,[109] 1895 ("Primäre Tuberkulose des Verdauungstractus," *Gazetta Bolknia*, 1895, No. 51, quoted in Lubarsch u. Ostertag's Ergeb. der Allg. Pathologie, 1899, p. 369), reports a case of primary tuberculosis of the intestinal tract, localized in the jejunum; from there it extended to the neighboring retroperitoneal and mesenteric glands and spleen. All other portions of the intestinal tract were normal.

.Cases 83 and 84. Von Ruck, 1899 (quoted in Dr. Salmon's Bulletin No. 33), reports two cases, father and child, which he considered almost conclusive. The former developed a case of acute miliary tuberculosis. The autopsy revealed no old focus in the chest or abdomen. The child, aged nearly one year, was first treated for fever and diarrhœa, but later developed symptoms of meningitis, and died. The milk which the child had received came from a Jersey cow, and no other had been used up to the time the diet was changed on account of the diarrhœal attack. The father had drunk from a pint to a quart twice a day, warm, at the time of milking, of this cow's milk. Upon post-mortem examination of the cow there was found extensive tuberculosis in the lungs and peritoneal cavity, and the lump in the udder contained a caseous centre, which, on examination, showed numerous well-stained tubercle bacilli.

Case 85. David Bovaird, Jr.,[109] 1891 ("A Case of Primary Intestinal Tuberculosis," *Archiv. of Pediatrics*, 1901, vol. xviii. p. 894), reports a case, aged three years, a patient of the New York Foundling Hospital. Family history, nothing known. No acute illness, but boy had always been weak and sickly. He was cared for outside the institution until August, 1899. The diagnosis of primary intestinal tuberculosis is based upon the autopsy findings. The oldest and most advanced lesions were in the mesenteric node.

The conclusion that the intestine has been the entry-port of the infection, Dr. Bovaird thinks can hardly be questioned. It was not possible to investigate the milk supply, but the case seemed to Dr. Bovaird to deserve to be classed as one of "Fütterungs-tuberculose."

Case 86. Ebers[109] (quoted by Bovaird) reports six cases in which tuberculosis in children was attributed to the consumption of the milk of tuberculous cows. Four of these, collected by Baum, were reported by Hermsdorf, Leonhardt and Sonntag. The remaining two were reported by Johne and Prümer. All but Prümer's case have already been presented in this table.

S. Delépine, 1898 ("A Lecture on Tuberculosis and the Milk Supply," *Lancet*, London, 1898, vol. ii. pp. 733–738), refers to Dr. Simcock's work in his laboratory, who selected thirteen cases of wasting in children, due to improper feeding, out of many more in which there was no evidence of tuberculosis in the parents or in the various organs of the children as examined in the post-mortem room. Dr. Simcock considered the cases free from tuberculosis, but Delépine was not quite convinced. On close examination of the mesenteric glands, two presented clear tuberculous lesions under the microscope and five more suggested the possibility of incipient tuberculosis.

Accidental Inoculation of Man with Bovine Bacilli (by Topical Application of Cream and Milk).

Grothan,[116] 1896, reports the case of a little girl, aged six years, suffering from an eruption on the left leg, supposed to be due to ivy poisoning. This was treated at home by the topical application of fresh cream. When seen by Grothan he recognized the characteristic appearance of a tuberculous ulcer. The cow was examined and the udder seemed normal, yet inguinal and intraperitoneal inoculation of two rabbits with a mixture of milk and cream gave positive results. The caseous material from the nodules of the girl's leg injected into the peritoneum of a rabbit produced death from tuberculous peritonitis.

Coppez,[117] 1896, reports the case of a girl, aged seventeen years, who had a wound on the palmar aspect of the third finger, which became infected with tubercle bacilli during milking. The original lesions gave rise to over thirty-five subcutaneous abscesses in different parts of the body within six months, and subsequently more appeared, in all sixty to sixty-six. At no time could any visceral lesions be recognized, the lymph nodes of the neck being greatly enlarged; after several months death ensued.

Priester,[118] 1896, p. 11, reports the case of a young man who tried to remove a number of tattooes from his hands and forearms by introducing milk into the tattooed parts by means of needle punctures. Later there appeared on the back of both hands at points which had been so treated bright red spots the size of millet seeds, containing a yellow center. Pus was evacuated from several nodules. These were found to be lupus nodules in which giant cells were demonstrated. The diseased parts were cut out and the wounds healed without a recurrence of the trouble.

Wound Infections.

L. Pfeiffer,[110] 1885, attended, at Weimar, a veterinarian, aged thirty-four years, of good constitution and without hereditary predisposition, who, in 1885, pricked his left thumb in making an autopsy on a tuberculous cow. The wound healed, but six months later the cicatrix still remained swollen, and in the autumn of 1886 the man had pulmonary tuberculosis, with bacilli in his sputa, and death occurred in two and a half years after the wound. Post-mortem revealed tuberculosis of the joint of the wounded thumb, and in the lungs extensive tubercles and vomicæ. The joint lesions showed caseous masses extraordinarily rich in tubercle bacilli.

Tscherning,[112] of Copenhagen, 1888 (*Proceedings of Congress for the Study of Human and Animal Tuberculosis*, first session, Paris, 1888, p. 275. Cited by Law, Bujwid,[110] and Salmon), attended a veterinarian who had cut his finger in making an autopsy on a tuberculous cow. The wound healed, but there remained a swelling which soon ulcerated and refused to heal, so that the whole tumefied mass had to be cut out. The microscope revealed a distinct tuberculous process and the presence of the characteristically staining bacilli. The patient recovered without further development of the disease.

T. A. Rich,[104] 1895. (*Veterinary Magazine*, December, 1895, vol. xi. p. 729.) Mr. T. cut his finger on a spicula of bone while making post-mortem examination of tuberculous cows. In a few weeks he developed a tuberculous joint and a few months later showed unmistakable signs of phthisis.

M. B. Hartzell,[111] Philadelphia (American Medical Association, June 1–4, 1897), reports a case of local infection in the back of the hand in the person of a previously healthy man employed to clean cars used for the transportation of cattle; the wound was caused by a piece of broken woodwork of a car, producing a typical verrucous tuberculosis, which appeared to yield to treatment. Within a year the patient developed pulmonary tuberculosis, and finally died from general tuberculosis.

M. P. Ravenel,[114] 1897, reports the case of a veterinarian who cut the knuckle of his forefinger while making a post-mortem examination of a tuberculous cow. The wound healed badly, remained swollen, and showed a decided tendency to ulcerate. Removal of the cicatricial mass was practised and the tissues sent to Dr. Ravenel for examination. They showed typical tuberculous lesions with giant-cell formation.

M. T. Naughton,[115] of Chicago, Illinois, 1899 (cited by Dr. Salmon, *Bulletin* No. 33, p. 19), reports the case of a man, aged thirty-four years, with a good family history, a butcher by occupation, who on May 3, 1899, while cleaning cattle viscera, fell, and a meat hook upon which hearts and lungs are hung penetrated the right hand between the second and third metacarpal bones. A tendovaginitis with some lymphangitis of the arm resulted; made a good recovery; four months afterward an abscess formed in the axilla, which was cleaned, and tubercle bacilli were demonstrated in the broken-down gland tissues. In three months afterward, or seven months from the original accident, he died from pulmonary tuberculosis.

M. P. Ravenel,[114] 1900, reports three cases of veterinarians in the State of Pennsylvania, of local infection from wounds in the finger inoculated accidentally with bovine tuberculosis in performing autopsies. In the first case a large giant cell but no tubercle bacilli were demonstrated in the excised portion. In the second case two guinea-pigs inoculated with a portion of the excised nodule developed a generalized tuberculosis, and in the third case Dr. John Guitéras demonstrated tubercle bacilli in the excised nodule.

Law,[113] 1901 (cited by J. J. Repp, *American Veterinary Review*, New York, 1901 and 1902, vol. xxv. pp. 624–636), reports that a young veterinary friend, who was inoculated in the hand in opening a tuberculous cow, suffered from a tumefaction of the resulting cicatrix in which tubercle bacilli were demonstrated.

M. P. Ravenel[129] reports the case of his assistant, who was inoculated with bovine tuberculosis, and from whose tissues tubercle bacilli were isolated after fifty-eight days.

C. H. H. Spronk[133] and K. Hoefnagel, 1900 and 1901 ("Transmission a l'homme, par inoculation accidentelle de la tuberculose bovine, et réinoculation experimentale au veau," *La Semaine méd.*, Paris, Ann. 22, No. 42, October 15, pp. 341–343; abstracted from *American Medicine*, November 8, 1902, p. 749), report the case of a butcher accidentally wounded, May, 1900, in the finger while assisting in inspecting the tuberculous organs of a cow. The wound healed promptly, but later the finger presented evidence of infection. In February, 1902, Professor Nareth extirpated the affected portion of the skin together with the tumefied cubital ganglia. The tuberculous character of the lesions was demonstrated by microscopic examination and by the inoculation of guinea-pigs, and an emulsion made from the spleen of one of these pigs was used to inoculate a calf previously tested with tuberculin, and the animal placed in a newly-constructed stable, with the result of producing general tuberculosis as demonstrated by the presence of giant cells and numerous tubercle bacilli. Finally two guinea-pigs which had been inoculated with material obtained from this calf died of tuberculosis.

Lassar[133] ("Ueber Impfluberkulose," *Deutsche med. Wochenschrift*, No. 40, October 2, 1902, pp. 716–718) reports thirty-four cases of verrucose tuberculosis following wounds in 108,000 patients, but only four of these cases were butchers. Later he examined 365 men employed in abattoirs and found seven suffering from inoculated tuberculosis, while three others he considered as possibly affected. (This shows a percentage of two to three among men employed in the abattoirs, and only one-third of one per thousand among persons otherwise employed.)

Hüls[133] ("Zur Frage der Uebertragung der Rindertuberkulose auf den Menschen, *Münch. med. Wochenschrift*, No. 24, June 17, 1902, pp. 1003 and 1004) reports the case of a wealthy miller's family, composed of the wife, five sons, and two daughters, herculean in stature, and boastful of strength and health. Consumption had never occurred in the family of either parent. Of these, all but two died from consumption within a few years, and even one of the surviving sons was treated for a tuberculous abscess of the finger. Hüls states that all these cases appeared subsequently to the introduction by the miller of a herd of Simmerthal cattle on his farm, which were nearly all infected with tuberculosis.

Krause[133] (quoted by Salmon) reports a case of a butcher, aged thirty years, with a good family history, whose duty it was to remove diseased parts of cattle killed for food. The infection was located in the right arm, and was attributed by the man to a splinter of wood run into his right thumb three years ago. Immediately after the accident he had removed the hide from a sick cow. Pieces of gland and skin from the arm proved on examination to be tuberculous.

Troje,[137] 1903, reports the case of a young, healthy male, who gave no personal or hereditary history of tuberculosis. He was inoculated with bovine tuberculosis on the hand, and a typical lupus lesion developed on the site of inoculation. Subsequently the lymphatic glands which drain the involved region became tuberculous, and in the course of time many other lymphatic glands throughout the body became similarly affected.

Recent Researches with Reference to the Communicability of Human Tuberculosis to Animals.

Chaveau's experiments (quoted by Salmon[2]) show that cattle were successfully infected with human tuberculous material by ingestion, intravenous injection, and by subcutaneous inoculation.

Sidney Martin,[133] 1895 (*Report of Royal Commission Appointed to Inquire into the Effect of Food Derived from Tuberculous Animals on Human Health*, London, Part I., 1895, pp. 9–11), also obtained successful results with bovine animals by feeding sputum.

Thomassen[133] ("The Receptivity of Bovine Animals for the Bacillus of Human Tuberculosis," *Transactions of the British Congress on Tuberculosis for Prevention of Consumption*, London, July 22–26, 1901, vol. iv. pp. 21–27) reports an experiment in which a calf was inoculated in the anterior chamber of the eye with a pure culture of tubercle bacillus isolated from a case of tuberculous arthritis in man. When killed, after six weeks, both lungs were found to contain numerous miliary tubercles and some gray fibrous tubercles of larger size. The path of infection from the eye could be traced by the lymphatic glands.

Nocard,[133] 1901 (*Press. Vét.*, Angers, vol. xxi., November 30, 1901, pp. 398–403), states that cattle are not refractory to human tuberculosis.

S. Arlong,[133] 1901 ("L'inoculabilité de la tuberculose humaine et des idées de M. Robert Koch sur cette tuberculose et la tuberculose animale," *Bull. acad. de méd.*, Paris, vol. lxv., 3 ser., xlvi., No. 43, December 24, 1901, pp. 897–911), reports experiments with three different cultures of human origin. One of these had been in his laboratory since 1896. It was capable of infecting guinea-pigs and rabbits by subcutaneous inoculations; and intravenous injection with an emulsion of this culture in a heifer calf, two sheep, and a kid conveyed the disease, as the autopsy demonstrated tuberculous lesions in all these animals.

M. P. Ravenel[122] reports having fed four calves with human sputum, and post-mortem examination proved that all had become affected with tuberculosis, the lesions in two being quite extensive. His inoculation experiments in calves and cows with cultures obtained from the mesenteric glands of a child which died of tuberculous meningitis proved very virulent for bovine animals.

De Jong[133] ("Experiences comparatives sur l'áction pathogène pour les animaux, notamment pour ceux dé léspèce bovine, des bacilles tuberculeux provenant du boeuf et de l'homme") reports a series of inoculations in seven bovine animals (calves and steers); all became tuberculous by the injection of tubercle bacilli of human origin. In one of the animals the disease was serious and extended; in four others it had a retrogressive tendency, and in two it was progressive. He concludes that bacilli isolated from the human body or from sputum are capable of causing tuberculosis in cattle.

J. Orth[133] ("Ueber einige Zeit-Streitfragen aus dem Gebiets der Tuberculose," *Berl. klin. Woch.*, August 25, 1902, pp. 793–978) showed by inoculation experiments that a progressive fatal tuberculosis was produced in the animals by material originating in the human subject.

Olof Stenström[133] ("Die Tuberculose des Menschen u. der Rinder," *Zeitschrift f. Thiermed.*, Band. vi. and vii., Heft 4, 1902, pp. 289–291), from his experiments, states that he found it quite easy to infect cattle with human tuberculosis.

Max Wolff,[133] 1902 ("Perlsucht und menschl. Tuberkulose," *Deutsche med. Woch.*, 28 Jahr., No. 32, August 7, 1902, pp. 566–570), reports inoculation from cases of primary tuberculosis of the intestines in man, from which he concludes that pearl disease of cattle may appear in man.

Johannes Fibiger and C. O. Jensen,[133] 1902 ("Uebertragung der Tuberculose des Menschen auf das Rinder," *Berl. klin. Woch.*, 39 Jahr., No. 38, September 22, 1902, pp. 881–886), conclude by stating that Koch announced that one could distinguish between human and bovine tuberculosis by inoculating calves subcutaneously. If this is true, then they are of the opinion that three of the calves cited in their experiments must be considered as perlsucht, and the idea that tuberculosis of cattle is not virulent for man is disapproved.

Dean and Todd,[133] 1902 ("Abstract of Certain Experiments on Tuberculosis," *Lancet*, London, November 1, 1902, pp. 1186, 1187), from their experiments conclude that the human tubercle bacillus is by no means innocuous to the calf, as the control animal injected directly with sputum contracted an extensive glandular tuberculosis.

E. v. Behring,[133] P. Romer and G. Ruppel (*Tuberculose*, xviii. p. 90, Marburg, 1902) report experiments in which human sputum was used to inoculate a guinea-pig, and a culture from this animal's spleen was used for inoculating a goat, and an emulsion of the spleen of the goat was passed through a series of guinea-pigs, and a culture obtained from the spleen of the third guinea-pig was inoculated into a calf by intravenous injections. The calf died after four weeks directly from the tuberculosis thus produced. A cow was also inoculated November 26, 1901, with a tuberculous culture of human origin after a single passage through a guinea-pig, and on January 14, 1900, the affected eye was enucleated and a pure culture was obtained from it after one passage through a guinea-pig. The cow at the close of the report was gradually losing ground.

De Schweinitz's[133] recent experiments with intravenous injections and inoculations of cultures obtained from the mesenteric glands of children affected with tuberculous peritonitis produced fatal generalized tuberculosis in calves, and a steer inoculated subcutaneously with a piece of tuberculous tissue from one of the children also produced tuberculosis.

Mohler's[133] experiments also show "that it is not a difficult matter to obtain very virulent tubercle bacilli from human sources, and that some of these are just as virulent as bovine bacilli."

A. Cipollina[135] reports that a monkey fed with bovine milk containing tubercle bacilli cultures contracted tuberculosis, with no primary lesions apparent in the gastrointestinal tract. On the other hand, inoculation of a calf with human bacilli resulted negatively.

BIBLIOGRAPHY.

1. Carmichael. Essay of the Nature of Scrofula, with Evidence of Its Origin from Disorders of the Digestive Organs. London, 1810.

2. Salmon, D. E. Relation of Bovine Tuberculosis to the Public Health. Bureau of Animal Industry, Bull. No. 33, 1901.

3. Casper, John Ludwig. Characteristic der französischen Medezin mit vergleichenden Hinblicke auf die englische, 8°, pp. 608. Leipzig, 1822, p. 134.

4. See also Dupuy. De l'affection tub. Paris, 1817.

5. de Schweinitz, E. A. A Preliminary Chemical Study of Various Tubercle Bacilli. E. A. de Schweinitz and M. Dorset. Biochemical Laboratory. Science, March 6, 1903, p. 377.

6. Klencke, Ph. Fr. H. Ueber Ansteckung u. Verbreitung der Scrophelkrankheit bei Menschen durch den Genuss der Kuhmilch, 90 pp. 12°. Leipzig, 1846.

7. Klencke Mikroskopisch-pathol. Beobachtungen über die Natur des Contagiun, vi. 167, pp. 80. Leipzig, Fest, 1843.

8. Johne, Alb. Die Geschichte der Tuberculose, etc. Deutsche Zeitschrift f. Thiermed u. vergl. Pathologie, 1883, vol. ix. p. 10; see also p. 57.

9. Villemin, G. Gaz. hebdom. de méd. de Paris, 1865, vol. xxxi. p. 211; Compt. rend., 1866, vol. lxi.

10. Roustan. Recherches sur l'inculabilite de la phthisie. Paris, 1867.

11. Gerlach. Jahresb. der Thierarzneischule zu Hannover, 1869.

12. Günther u. Harms (see 11) and Gurlt and Hertwig's Mag. der ges. Thierheilk., vol. xxxvii.

13. Oesterr. Vierteljahrschrift f. wissenschaft. Thierheilk., vol. xxxi.

14. Bagge. Rep. de Thierheilk., v. Hering, vol. xxxii.

15. Zürn. Zoopathol. u. zoophysiol. Untersuchungen, 1872.

16. Bollinger. Archiv f. experiment. Pathologie, 1873, vol. i. p. 257.

17. Biffi u. Verga. Gazett. med. Ital., 1873, No. 52.

18. Bouley. Compt. rend., 1880, No. 26.

19. Aufrecht. Pathol. Mittheilungen, Magdeburg, 1881.

20. Toussaint. Rec. de méd. vét., 1880, p. 31. Compt rend., Tom. xciii., No. 5, p. 281; No. 6, p. 322.

21. Klebs. Virchow's Archiv, 1870, vol. xlix. p. 292.

22. Kitt. Ber. der Münchener Thierarzneischule, 1879-80, p. 28.

23. Semmer, Thal u. Nesterow. Deutsche Zeitschrift f. Thierm. u. verg. Path., Band. ii. p. 209.

24. Cohnheim und Salomonson. Allgem. med. Centralzeitung, 1877, No. 65.

25. Hänsell and Deutschmann. Archiv f. Opthalm., Band xxv. pp. 1 and 25.

26. Baumgarten. Berl. klin. Wochenschrift, 1880, No. 49.

27. Tappeiner. Virchow's Archiv, Band lxxiv. p. 393; Band. lxxxii. p. 353.

28. Lippl. Archiv f. klin. Med., Band xxvi. p. 523.

29. Gerlach. Archiv f. wissensch. u. pract. Thierheilk., Berlin, Band i. p. 6; see also 11.

30. Chauveau. Jour. de Méd. Vét., 1869, vol. xxv. p. 5; Gaz. Méd. de Lyon, 1870, No. 5; Rec. de Méd. Vét., 1872, p. 327: 1873, p. 929; Gaz. Hebdom. de Méd. de Paris, 1874; Bull. de l'academie de Méd., 1875, p. 891.

31. Arch. f. experim. Pathol., 1873, Band i. p. 357; Deutsche Zeitschrift f. Thierm. u. vergl. Pathol., 1880, p. 103.

32. Roloff. Zeitschrift f. pract. Vet. Wissenschaft. Berne, 1874, Band xi. p. 33.

33. Brell. Deutsche Zeitschrift f. Thiermed. u. ver. Pathol., 1877, Band iv. p. 290.

34. Metzguer. Rep. d. Thierhk. v. Hering, 1878, p. 57.

35. Langeron. Der Thierarzt, 1878, Band xvii. p. 149.

36. Blumenberg. Deutsche Zeitschrift f. Thierm. u. vergl. Pathol., 1879, vol. v. p. 319.

37. Orth. Virchow's Archiv, 1879, Band lxxvi. p. 217.

38. Lange. Deutsche Zeitschrift f. Thierm. u. vergl. Pathol., 1880, Band vi. p. 309.

39. Peuch. Compt. rend., 1879, No. 26, and 1880, vol. xc., No. 26.

40. Peuch and Toussaint. Archiv. Vétérin, 1881, No. 15.

41. Aufrecht. Med. Centralbl., 1882, p. 289.

42. Bollinger. Tagebl. der 52 Vers. deutscher Naturf. u. Aerzte, Baden-Baden, 1879, p. 264.
43. Klebs. Arch. f. exp. Pathol., Band i. p. 162.
44. Virchow. Berl. klin. Wochenschrift, 1880, vol. xvii. pp. 189-194.
45. Schoengen. Mag. f. d. ges. Thierheilk., 1873, vol. xl. p. 91.
46. Leonhardt, K. Correspondblt. d. nieder-rhein. Ver. f. öffentl. Gesundh, 1877, p. 213.
47. Bollinger and Stang. Aerzt. Intelligbl. München., January 25, 1876, xxxii. Jahr., p. 34.
48. Demme, R. 17th Med. Bericht d. Jenner Kinderspital's Bern f. 1879, pp. 27-30; also 20th Report, 1882, p. 48; also 24th Report, 1886, p. 20.
49. Epstein, Alois. Viertelj. f. d. pract. Heilk., 1879, vol. xi. pp. 103-127.
50. Uffelmann, J. Arch. f. Kinderheilk., 1880, vol. i. p. 433.
51. Law. Nat. Board of Health Bull., 1880-81, vol. ii. p. 455.
52. Creighton, C. Bovine Tuberculosis in Man. London, 1881.
53. Koch. Die Aetiologie der Tuberculose. Berl. klin. Wochen., April 10, 1882, Band xix., Heft 15, pp. 221-230.
54. Csokor. Archiv f. wissensch. u. pract. Thierheilk., 1882, p. 174.
55. Bang. Ueber Euterbuberculose, etc. Deutsch. Zeitschrift f. Thiermed. u. vergl. Pathol., 1885, p. 45.
56. Johne. Ibid., 1885, p. 18.
57. Bollinger. Ueber Tuberkelbacillen im Euter, etc. Bayr. aerzl. Int. Bl., 1883, No. 16.
58. May. Archiv f. Hygiene, 1883, Band i. p. 121.
59. Ernst. American Journal of the Medical Sciences, November, 1889, p. 439. Infectiousness of Milk: Result of Investigations Made for the Massachusetts Society for the Promotion of Agriculture. Boston, 1895.
60. Woodhead and MacFadyean. Report of British Medical Association. Dublin, 1887, No. 86, p. 979.
61. Martin. Report of the Royal Commission on Tuberculosis, April, 1895.
62. Nocard. Les Tuberculoses animales. Encycl. Scient. des aides mém., Paris, 1895.
63. Stein. Inaugural Dissert. Berlin, 1884.
64. Hirschberger. Experiment. Beitr. zur Infect. der Milch tuberc. Thiere. Archiv f. klin. Med., 1889.
65. Smith, Theobald. Misc. Investigations Concerning Infections, etc. Bull. No. 3, U. S. Bureau of Animal Industry, 1893, pp. 60-66.
66. Rabinowitsch and Kempener. Zeitschrift f. Hygiene u. Infections, vol. xxx. p. 137.
67. Dollar, J. A. W. Tuberculosis and the Milk Supply. Veterinarian, London, 1901, vol. lxxiv. pp. 393-400.
68. Kanthack and Sladen. Medical Press and Circular, London, 1899, n. s., vol. lxviii. pp. 55-57.
69. Baum, H. Gefahren d. Milchgenusses f. d. Menchen. Archiv f. Thierheilkunde, 1892, vol. xviii. pp. 187, 196.
70. Baumgarten. Ueber die Uebertragbarkeit der Tuberculose. Centralbl. f. klin. Medicin., 1884, p. 25.
71. Wesener. Kritische u. experim. Beitr. zur Lehre von der Fütterunsgstuberculose, Freiburg, 1885, pp. 49-70.
72. Fischer. Archiv f. exp. Patholog. u. Pharmac., 1886, Band xx. p. 446.
73. Peuch. Sur la transmissibilitie de la tuberculose par le lait. Comptes rendu, T. xc., No. 26, p. 1581.
74. Ernst. See 59; also Report for the Massachusetts Society for Promoting Agriculture. Boston, 1895.
75. Falk. Ueber d. Verhalten v. Infectionstoffen im Verd. Kanale. Virchow's Archiv, 1883, Band xciii. pp. 117.
76. Zagari. Sul Passagio del virus tuberculare pel tubo degenende del cane. Giornale intern. delle Scienzeo, Med., 1889.
77. Gebhardt. Virchow's Archiv, 1890, Band cxix. p. 127.
78. Dobroklonski, v. Quoted by Bovaird and Salmon. De la pénétration des bacilles tuberculeaux dans l'organisme a traverse la muqueuse intestinale et du développement de la tuberculose expérimentale. Arch. de Méd. expér. et d'anat path., Paris, 1890, 1 ser. v. 2, pp. 253-271.
79. Desoubry, G., and Porcher, Ch. Quoted by Salmon. De la présence de microbes dans le chyle normal chez le chien. Compt. rend. Soc. de Biol., Paris, v. 47, 10 sér. v., No. 5, February 15, 1895, pp. 101-104.
80. Nicolas, J., and Descos, A. Passages des bacilles tuberculeaux après ingestion dans les chylifères et el canal thoracique. Jour. de Physiol. et de path. gén. of Paris, September 15, 1902, v. 4, No. 5, pp. 910-912.
81. Editorial, Tuberculosis and the Milk Supply. Lancet, London, 1890, 1, p. 395.

82. Günther and Harms. Jahresber. der Thierärzl. Arzneischule, Hannover, 1873, pp. 75, 107.

83. Siedamgrotzky. Tuberc. Uebertragungsversuche. Arch. f. wiss. u. pract. Thierheilk., 1882, 174.

84. Nosotti. Giornale della Societa Ital. d'Igiene, 1885, vii. 2, p. 87.

85. Schreiber. Zur Lehre von der artif. Tuberculose. Dissertation. Königsberg, 1875.

86. Lucas und Morro. Uebertragung der Rindertuberc. auf Schweine, Hühner durch milchgenuss. Berliner Archiv, 1885, p. 104.

87. Utz. Zur Fütterungstuberc. beim Schweine. Bad. Mittheil., 1888, p. 7.

88. Klebs. Die Künstliche Tuberculose. Mittheilungen, 1882, p. 20.

89. Kruckow. Ueber Tuberculose, ibid., p. 20.

90. Pfennigwerth. Sächsischer Jahrb., 1889, p. 119.

91. Vollers. Mittheil. a. d. Thierärztl. Praxis in Preussichen Staate, N. F., Band xi. p. 101.

92. Woodhead, G. Sims. Milk and Disease. Medical Press and Circular, 1888, xiv. p. 267.

93. Law. Papers and Addresses of the New York State Vet. College of 1896–98, p. 85. Quoted by Salmon, Repp, and others.

94. Demme. (See 48, Report for 1886, p. 20.)

95. Meyerhoff, H. Ueber die Contagionstät der Tuberculose. Zeitschrift f. klin. Med., 1884, vol. viii. pp. 575–579.

96. Hermsdorff. Ueber primäre Intestinal Tuberculose. Inaugural Dissertation, München.

97. Northrup. THE AMERICAN JOURNAL OF THE MEDICAL SCIENCES, 1890, vol. c. p. 268.

98. Ollivier. Berliner Thierärztl. Wochenschrift, January 22, 1892, p. 42.

99. Wyss, Oscar. Corresp.-Bl. f. Schweitzer Aerzte, 1893, vol. xxxiii. p. 745.

100. Gosse. Jour. de Genève, October 31, 1893.

102. Rotch and de Schweinitz. Quoted by Salmon. Bulletin No. 33, p. 20, Bureau of Animal Industry, U. S. Dept. of Agriculture, 1901.

103. Law. Bull. No. 65, Cornell Univ. Exp. Station, 1894. Quoted by Bovaird. Archiv. of Pæd., December, 1901.

104. Rich, T. A. Relation between Human and Bovine Tuberculosis. Veterinary Magazine, December, 1895, vol. ii. p. 729.

105. Smith, J. L. Tuberculosis Originating in Intestinal Infection. Archives of Pædiatrics, New York, 1896, vol. xiii. p. 52.

106. Brouardell. Quoted by Harrington, from Annales d'Hygiène, publ. xxiv. p. 65.

107. von Ruck. Quoted by Salmon, Bull. No. 33.

108. Hills. Bull. No. 42, Vermont Vet. Experim. Station, p. 55.

109. Prümers. Quoted by Bovaird. Archives of Pædiatrics, December, 1901, vol. xviii.

110. Pfeiffer, L. Zeitschrift f. Hygiene, 1888, Band iii. p. 209. Quoted by Bugwid, Oest. San. Wesen., Wien, 1898, x. Beil. z., No. 41, p. 7–21. Also by Salmon, Bull. No. 33, p. 17.

111. Hartzell. Quoted by Salmon, Bull. No. 33, p. 17.

112 Tscherning. Quoted by 110 and 111.

113. Law. Quoted by Repp. American Vet. Review, New York, 1901–2, vol. xxv. pp. 624, 636.

114. Ravenel, M. P. Three Cases of Tuberculosis of the Skin, due to Inoculation with the Bovine Tubercle Bacillus. Philadelphia Medical Journal, July 21, 1900; Medicine, Detroit, July and August, 1902.

115. Naughton, M. T. Quoted by Salmon, Bull. No. 33, p. 19.

116. Grothan. Quoted from Omaha Clinic, February, 1896, by Salmon, Bull. No. 33, p. 17.

117. Coppez. Cited by Theob. Smith, Journal of Experimental Medicine, vol. iii. p. 505; also by Salmon, Bull. No. 33, p. 18.

118. Priester. Cited by Salmon, Bull. No. 33, p. 18, from the Proceedings of Congress for the Study of Human and Animal Tuberculosis, 1st sess., Paris, 1888, p. 275, and Zeitschrift f. Med. Beamte, 1896, p. 11.

119. Smith. Transactions of the Association of American Physicians, 1896, vol. ix. p. 75.

120. Smith. A Comparative Study of Bovine Tubercle Bacilli and of Human Bacilli from Sputum. Journal of Experimental Medicine, vol. iii. pp. 451–511.

121. Koch. Cited by McFadyean, Journal Comp. Pathol. and Therap., Edinburgh and London, 1901, vol. xiv. pp. 215–224.

122. Ravenel, M. P. Medicine, Detroit, July, 1902, vol. viii., No. 7, pp. 529–546; August, No 8, pp. 617–632.

123. de Schweinitz and Mohler. Cited by Salmon in an unpublished report on Animal Diseases, submitted to the American Public Health Association (New Orleans meeting, 1903).

124. Orth, J. Cited by Salmon, ibid., from Berlin. klin. Wochenschrift, August 25, 1902.

125. de Jong, A. Cited by Salmon, ibid., from Ann. de méd. Vét., Bruxelles, 1902, vol. li., No. 4, ap., pp. 181–190.

126. Vagedes. Experiment. Prüfung der Virulenz v. Tuber-bacillen. Zeitschrift f. Hyg. und Infect., August 19, 1898, v. 28, pp. 276–320.

127. Lartigan, A. J. A Study of the Variations in Virulence of the Bacillus Tubercle in Man. Boston Journal of Medical Research, July, 1901, vol. vi., No. 62, pp. 156–162.

128. Delépine, Sheridan. British Medical Journal, London, September 27, 1902, p. 947.

129. Ravenel, M. P. Transactions of the British Congress on Tuberculosis, etc. July, 1901, vol. i. pp. 91, 92.

130. Heller. Cited by Salmon, from München. med. Wochenschrift, 1902, 49 Jahrg., No. 15, ap. 15, pp. 609–611.

131. Bovaird, D. Collection of Primary Intestinal Tuberculosis. Archives of Pediatrics, December, 1901, vol. xviii.

132. Gottstein. Cited by Salmon, from München. med. Wochenschrift, October 8, 1901, Band xlviii., No. 41, pp. 1610–1612.

133. Salmon, D. E. Report of the Committee on Animal Diseases, submitted to the American Public Health Association, New Orleans meeting, 1903. Not yet published.

134. Jacobi, A. Notes on Cow's Milk and Infant Tuberculosis. New York Medical Journal, January 25, 1902, pp. 134-136.

135. Cipollina, A. Beitrag zu dem Studium der Rinder und menschlichen Tuberculose. Berlin. klin. Wochenschrift. Abstract in Journal of the American Medical Association, March 28, 1903.

136. Hand, Alfred, Jr. Autopsy Statistics at the Children's Hospital, with Reference to Tuberculosis and Its Etiology. Proceedings of the Pathological Society of Philadelphia, March, 1903.

137. Troje. Deut. med. Wochenschrift, March 12, 1903. Abstract in Medical Record, April 11, 1903, p. 590.

TABES IN THE NEGRO.*

By D'Orsay Hecht, M.D.,

INSTRUCTOR IN NEUROLOGY, NORTHWESTERN UNIVERSITY MEDICAL SCHOOL, CHICAGO.

About the negro much has been set down in the annals of anthropology, ethnology, and sociology, and a glance at medical literature as it appears in summary form from year to year would suggest that almost the last word has been written about tabes; but of tabes in the negro I have been able to obtain only the fewest references recorded, in the main, by American writers. Von Leyden[1] quotes Buri as sponsor for the statement, "*bei den so häufig syphilitischen Negern soll die Tabes sehr selten vorkommen*" (tabes occurs very rarely in the large number of syphilitic negroes). In another foreign contribution to the literature of this subject, entitled "*La Ataxia Locomotriz* (*en el negro*),"[2] is recorded the fact of tabes occurring eight times in full-blooded negroes and three times in mulattoes.

C. W. Burr[3] in a report on "The Frequency of Locomotor Ataxia in Negroes," read before the Philadelphia Neurological Society, 1892, prefaces the comments on his own case with the written opinions of many Southern practitioners, all of whom were unanimous in declaring tabes in the negro of rare occurrence. Professor Osler is also quoted, in answer to Dr. Burr's query, as stating "of twenty cases under

---

* Read at the meeting of the Chicago Neurological Society, October, 1903.